

## Sero-pattern and Occupational Risk Factors Associated with Hepatitis B Virus Infection Among Health Care Workers at Wad Medani Teaching Hospital, Sudan

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### Abstract:

Hepatitis B virus (HBV) infection is a major public health problem worldwide. This cross-sectional study was conducted to detect the rate of HBV and risk factors among health care workers (HCWs) using different serological markers. Two hundred and fifty HCWs comprised physicians, lab specialists, nurses, employers, and wash workers. The HBV serological markers were analyzed using ELISA and Cobas411e. Out of 250 HCWs, 103 (41.2%) were males and 147 (58.8%) were females. HBsAg, HBeAg, HBeAb, and total HBcAb were detected in 2.8%, 2.0%, 4.4%, and 37.6% of study participants, respectively. Wash workers are the most vulnerable group, followed by employers and nurses. Furthermore, 115 (47.3%) HCWs were vaccinated and produced no HBsAg. The study spotlights to the positive impact of vaccination in reducing the prevalence of HBV infection, and also recommends the implementation of vaccination and hygiene policies to ensure a higher level of infection control.

**Keywords:** HBV serological markers, Health Care Workers, Vaccination, Good Hygiene policies

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### Introduction:

Hepatitis B virus (HBV) infection is a major public health problem worldwide. More than two billion people have been infected with HBV, and 400 million are considered carriers of the virus (1-3). The World Health Organization (WHO) estimated that, the prevalence of hepatitis B virus infection is more than 10% (4), that there are 360 million people in the world chronically infected with HBV in sub-Saharan Africa and East Asia

(5), and that 65 million are found in Africa. Thus, Africa, carries approximately 18% of the global burden of HBV infection (6). Regions of the world with high or intermediate prevalence of Hepatitis B surface antigen (HBsAg) include much of Eastern Europe, Asia, Africa, the Middle East, and the Pacific Islands. The majority of new infections occur in countries with low endemicity (i.e., HBsAg prevalence of less than 2%) (7,8).

Health practitioners or health care workers (HCWs) are at high risk for exposure to HBV from infected patients, and when accidentally stuck with a contaminated needle or other sharp medically used instrument, they may potentially transmit HBV to patients too (4,5,9). The frequencies of exposure to infected body fluids or blood-contaminated sharps, as well as the duration of employment in an occupational risk category, have been shown to be associated with the risk of HCWs acquiring occupationally related HBV infection. Sudan is classified among countries with high HBsAg endemicity (Mudawi, 2008). Exposure to HBV infection ranges from 47% to 78% HBsAg, with sero-prevalence ranging from as low as 6.8% in central Sudan to as high as 26% in southern Sudan (10). In previous studies, the occupational risk of HBV infection among the HCWs was high among nurses in Khartoum State (11), and among nurses and cleaning staff in Omdurman State (12). Serologic markers for HBV were detected in 843 HCWs in Al-shaab Teaching Hospitals in Khartoum State, and the prevalence of anti-HBc, HBsAg, HBsAb, and HBeAg was found to be 57%, 6%, 37%, and 9%, respectively (13). Chronic hepatitis B infection was found in 2.9 percent of tertiary hospital employees in Rwanda (14), 8.1 percent in Uganda [4], and 13 percent in Nigeria (15). Apparently there are considerable differences in the rate of chronic HBV-infection among HCWs in sub-Saharan Africa (5). Whereas the literature on hepatitis B virus infection in Sudan is growing, there is still a

paucity of information on HBV among HCWs, particularly in the Sudan outskirts. This study contributes to this discourse by presenting and determining the prevalence and occupational risk factors of HBV infection among HCWs and also providing updated guidelines for the most informative marker in screening policies.

### **Method**

From March to May 2022, a cross-sectional study was carried out at Wad Medani Teaching Hospital, Sudan's largest referral hospital. The study subjects were divided into five groups, each with 50 participants. These groups include physicians, laboratory specialists, nurses, employers, and washing workers. All the participants were informed of the study objectives. Ethical approval was obtained from the ethical review board of the University of Gezira, the Faculty of Medical Laboratory Sciences, and the Ministry of Health in Gezira State. Two types of data were collected and analyzed for each participant: (1) Demographic and risk factors were collected using a structured questionnaire and analyzed using a computer-based software program. (2) Clinical data (blood samples) were collected according to standard instructions for blood sample collection, then carried out and analyzed at the Blood Bank Department of the same hospital, the Prime Design Center for Training and Human Resources Development, and the Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, University of Gezira. Five ml of venous blood were collected from each

participant in a plain tube and were transported immediately to the laboratory, where serum was separated and tested for HBsAg using an enzyme-linked immunosorbent assay (ELISA), which performed according to manufacturer instructions (Fortress Diagnostics; Batch: hhbs-1407-1; Code: UK). HBeAg, HBeAb, and HBcAb were measured based on the protocol provided with the automated Cobas411e machine (Roche Diagnostics GmbH, Germany).

**Statistical analysis:** A comparative statistical analysis was performed using the statistical program SPSS version 20 for the variables. Descriptive statistics were calculated in the form of frequency with percentages for categorical variables. Associations between seropositivity and risk factors were estimated and tested by the chi-square test. P value less than 0.05 was

considered significant. The ICT's sensitivity, specificity, and predictive values were also calculated.

### Results:

In this study, 250 HCWs were recruited to participate. The study subjects were randomly selected but equally distributed (50 cases each) according to their profession: physicians, lab specialists, nurses, employees, and wash workers. Among the total, 41.2% (103/250) were males and 58.8% (147/250) were females. Table 1 showed that the largest group (38.8%) is between the ages of 26 and 35. Table 2 showed that 2.8% (7/250) were positive for HBsAg when using ELISA. 4.4% and 2.0% of all participants were positive for HBeAb and HBeAg, respectively. Moreover, 37.6% of participants tested positive for IgG HBcAb.

**Table1. Demographic characteristics of 250 HCWs participated in this study (N=250).**

Characteristics	Frequency (%)
<b>Gender</b>	
Male	103 (41.2%)
Female	147 (58.8%)
Total	250 (100%)
<b>Age group (years)</b>	
15-25	74 (29.6%)
26-35	97 (38.8%)
36-45	55 (22.0%)
46-55	21 (8.4%)
56 and more	3 (1.2%)
Total	250 (100%)

**Table 2. Frequency and percentages of HBV serological markers among study subjects.**

Serological Markers	Positive (%)	Negative (%)	Total
HBsAg (ELISA)	7 (2.8%)	243 (97.2%)	250 (100%)
HBeAb	11 (4.4%)	239 (95.6%)	250 (100%)
HBeAg	5 (2.0%)	245 (98.0%)	250 (100%)
HBcAb IgG	94 (37.6%)	156 (62.4%)	250 (100%)
HBcAb IgM	0 (0.0%)	250 (100%)	250 (100%)

**Table 3. Percentage and frequency of HBV serological markers among HCWs (N= 250)**

HCWs	Serological Markers	Positive (%)	Negative (%)
Physicians	HBsAg	0 (0%)	50 (100%)
	HBeAb	0 (0%)	50 (100%)
	HBeAg	0 (0%)	50 (100%)
	HBcAb IgG	5 (10%)	45 (90%)
	HBcAb IgM	0 (0%)	50 (100%)
<b>Total</b>		<b>5 (2.0)</b>	<b>245 (98.0)</b>
Lab. Specialist	HBsAg	0 (0%)	50 (100%)
	HBeAb	0 (0%)	50 (100%)
	HBeAg	0 (0%)	50 (100%)
	HBcAb IgG	12 (24%)	38 (76%)
	HBcAb IgM	0 (0%)	50 (100%)
<b>Total</b>		<b>12 (4.8)</b>	<b>238 (95.2)</b>
Nurse	HBsAg	1 (2%)	49 (98%)
	HBeAb	1 (2%)	49 (98%)
	HBeAg	1 (2%)	49 (98%)
	HBcAb IgG	20 (40%)	30 (60%)
	HBcAb IgM	0	50 (100%)
<b>Total</b>		<b>23 (9.2)</b>	<b>227 (90.8)</b>
Employers	HBsAg	4 (8%)	46 (92%)
	HBeAb	3 (6%)	47 (94%)
	HBeAg	0	50 (100%)
	HBcAb IgG	23 (46%)	27 (54%)
	HBcAb IgM	0	50 (100%)
<b>Total</b>		<b>30 (12.0)</b>	<b>220 (88.0)</b>
Wash-worker	HBsAg	2 (4%)	48 (96%)
	HBeAb	7 (14%)	43 (86%)
	HBeAg	4 (8%)	46 (92%)
	HBcAb IgG	34 (68%)	16 (32%)
	HBcAb IgM	0	50 (100%)
<b>Total</b>		<b>47 (18.8)</b>	<b>203 (81.2)</b>

**Table 4: Association between HBsAg infection and possible risk factors.**

Risk factor		HBsAg using ELISA		P value
		Positive (N=7)	Negative (N=243)	
Occupations	Physicians	0 (0.0%)	50 (20.6%)	0.03
	Lab Specialists	0 (0.0%)	50 (20.6%)	
	Nurse	1 (14.3%)	49 (20.2%)	
	Employers	4 (57.1%)	46 (18.9%)	
	Wash Workers	2 (28.6%)	48 (19.7%)	
Age groups/year	15-25	0 (0.0%)	74 (30.4%)	0.221
	26-35	4 (57.1%)	93 (38.2%)	
	36-45	2 (28.6%)	53 (21.8%)	
	46-55	1 (14.3%)	20 (8.3%)	
	56<	0 (0.0%)	3 (1.3%)	
Gender	Male	5 (71.4%)	98 (40.3%)	0.099
	Female	2 (28.6%)	145 (59.7%)	
Job duration/hours	3-6	1 (14.3%)	15 (6.2%)	0.299
	7-10	2 (28.6%)	166 (68.3%)	
	11-15	3 (42.8%)	40 (16.4%)	
	16-24	1 (14.3%)	22 (9.1%)	
Surgery exposure	Exposed	3 (42.9%)	73 (30.0%)	0.467
	Not exposed	4 (57.1%)	170 (70.0%)	
Blood transfusion	Yes	0 (0.0%)	23 (9.5%)	0.393
	No	7 (100%)	220 (90.5%)	
Sprocket took off	Exposed	4 (57.1%)	126 (51.9%)	0.782
	Not exposed	3 (42.9%)	117 (48.1%)	
Vaccination	Yes	0 (0.0%)	115 (47.3%)	0.013
	No	7 (100%)	128 (52.7%)	
Infected family members	Yes	0 (0.0%)	15 (6.2%)	0.498
	No	7 (100%)	228 (93.8%)	
Cigarette smoking	Yes	1 (14.3%)	23 (9.5%)	0.669
	No	6 (85.7%)	220 (90.5%)	

**Discussion:**

In this study, health-care workers (HCWs) are defined as those who have direct or indirect contact with patients and/or clinical samples while working at Wad Madani Teaching Hospital. This is the first study conducted in Wad Madani city to detect the hepatitis B virus among HCWs. The prevalence of HBsAg was 2.8% in the current study, while a higher prevalence (6%) was identified by Elmokashfi in 2012 in Al-Shaab

Teaching Hospital in Khartoum State (13). This finding was almost identical to a study conducted in Nigeria last year, which found the prevalence of hepatitis B among HCWs to be 2.3% [8]. It was also found to be lower than the prevalence reported in Tanzania (5.7%) (16), Nigeria (17%) (17), Uganda (8.1%) [4], and Najran in Saudi Arabia (8.7%) (18). An exposure that might place HCWs at risk for infection may be a percutaneous injury, contact of the mucous membrane and non-

intact skin with blood, tissue, or other body fluids that are potentially infectious (19). According to Bond and his colleague, at health care centers, when there are no regulations for safe practice during dealing with patients, daily hygiene, and medical waste, the wash workers and nurses will be at high risk for infections. The employers can also get infected by means of contaminated surfaces. HBV has been demonstrated to survive in dried blood at room temperature on environmental surfaces for weeks (20), and this may likely cause HCWs to be more vulnerable toward infection than the general population. HBV is more infectious than other blood-borne viral pathogens and is about 100 times more infectious than HIV (21). This infectiousness could be explained by its higher viral load in the blood, longer viability in the environment (more than 7 days at room temperature), and transmissibility in the absence of visible blood [21]. HBsAg was found in 8% of employers and 4% of wash-workers. This finding is nearly in agreement with a study conducted in Addis Ababa (6.3%) (22), and this may be different from what was obtained by Shao and his colleagues in Tanzania, who detected that physicians were the leaders, followed by nurses and laboratory specialists (16). It was also reported by U.S. Public Health Service Guidelines that wash workers are more exposed to HBV infection than other HCW (21). Indirect inoculation through improperly collected and/or segregated sharp materials is considered an occupational hazard for wash workers (21, 23). The difference within

HCWs might be explained by the different levels of both the risk of exposure to infectious materials and awareness of the safe practice of daily hygiene. The vaccination against HBV has had a significant impact on reducing the number of people infected with HBV. It remains the most important strategy for the protection of HCWs from HBV infection. Despite the fact that all HCWs should be vaccinated against HBV, only 47.3% of study participants were. The non-vaccinated worker may present themselves as a risk for HBV infection. Beside this study, several studies found that other factors such as job duration, surgery exposure, infected family members, and sprocket takeoff may not increase the risk of HBV infection (24, 25). The serologic markers of HBV are varied and complex. HBsAg is used as a routine diagnostic serological marker for HBV infection at Wad Madani Teaching Hospital [26]. And there are two reasons for using HBsAg and the ELISA technique: firstly, the ease, availability, and cost of the surface antigen test kit. Secondly, the cost, reliability, and confidence related to the ELISA technique are relevant to the area of study. The normal sequence of serological events in the course of hepatitis B infection is now well characterized. Signs of active virus replication, including HBsAg supported by the presence of HBeAg, were observed among the nurses and wash workers. They may transmit the infection to other workers, patients, and their family members. In contrast, none of the physicians and laboratory specialists presented the outcome of surface or envelope

antigen; instead, a minority of them produces HBcAb-IgG only, which indicates previous infection or exposure to the hepatitis B virus in an undefined time frame. These findings highlight the need to continue improving the working environment of HCWs by providing hepatitis B vaccination and following hygienic policies in the hospital. The vaccination program for HCWs should continue to be implemented within the framework. It is mandatory to expand this study to include the remaining health care workers in order to identify carriers and chronic cases in the hospital and formulate evidence-based data for action. To reduce the prevalence of HBV among HCWs, a new strategy is needed to reduce occupational exposure to blood and body fluids by maintaining adequate personal protective equipment supported by regulations, and mandatory vaccination against hepatitis B is required for HCWs as they are among the risky groups in the community. In addition, continuous training on infection prevention procedures should be provided for all HCWs.

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